

APPENDIX K

SUPPORTING INFORMATION
FOR SOILS

SOILS

Information in this appendix is supplemental to the discussion of the Affected Environment Section 3.8 on soils, topography, and erosion of the alternative sites. Additionally, Best Management Practices for preventing and controlling soil erosion are discussed.

Soil Erosion Potential

Many factors control the erosion potential of soils. Two discussed below are susceptibility to water erosion and wind erodibility.

Susceptibility to Water Erosion

Erosion factor K gauges soil susceptibility to water and is based on percent soil content of silt, sand and organic matter, and on soil structure and permeability. K factor values range from 0.05 to 0.69. Soils with the highest susceptibility to water erosion are assigned a value of 0.69 (U.S. Department of Agriculture, 1995). K factors for alternative location soils are presented in Table K-1.

Wind Erodibility

Wind Erodibility is expressed as a soil grouping index of 1 to 8. The group number is based on sand, silt, and clay content and the susceptibility soils of various contents have to being blown by wind. Sandier soils have the highest wind erodibility and are assigned to Group 1. Soils with the lowest wind erodibility are assigned to Group 8 (U.S. Department of Agriculture, 1995). Wind erodibility of alternative soils is presented in Table K-1.

Table K-1. Erosion Potential of Alternative Location Soils

Location	Soil Type	Approximate Percent Coverage	Erosion Potential	
			K factors	Wind Erodibility Group
Camp Pinchot	Lakeland Sand	100%	.10	2
Camp Pinchot Expansion				
Poquito Bayou Housing	Lakeland Sand	65%	.10	2
	Dorovan Muck	15%	.10	2
	Resota Sand	5%	.10	1
	Chipley and Hurricane	15%	.10 - .15	2
Poquito Bayou Expansion	Lakeland Sand	90%	.10	2
	Foxworth Sand	3%	.10	2
	Udorthents	3%	.20	7
	Dorovan Muck	2%	.10	2
	Chipley and Hurricane	2%	.10 - .15	2
Old Plew/New Plew Expansion	Lakeland Sand	100%	.10	2
New Plew				
Old Plew				
Camp Rudder	Lakeland Sand	100%	.10	2

Table K-1. Erosion Potential of Alternative Location Soils Cont'd

Location	Soil Type	Approximate Percent Coverage	Erosion Potential	
			K factors	Wind Erodibility Group
Capehart Housing	Lakeland Sand	89%	.10	2
	Foxworth Sand	10%	.10	2
	Dorovan Muck	1%	.10	2
Wherry Housing	Lakeland Sand	100%	.10	2
Ben's Lake Housing	Lakeland Sand	100%	.10	2
Live Oak Terrace	Dorovan Muck	10%	.10	2
	Rutledge Sand	90%	.10 - .17	N/A
Pine Shadows	Chipley and Hurricane Sand	15%	.10 - .15	2
	Dorovan Muck	15%	.10	2
	Urban Land	25%	N/A	N/A
	Mandarin Sand	5%	.10 - .15	2
	Resota Sand	40%	.10	1
Soundside Manor	Lakeland Sand	45%	.10	2
	Dorovan Muck	30%	.10	2
	Mandarin Sand	20%	.10 - .15	2
	Resota Sand	3%	.10	1
	Rutledge Sand	2%	.10 - .17	N/A

Soil Types

Lakeland Series

Soil type across all alternative locations is predominantly Lakeland Sand. The Lakeland series consists of very deep, very strongly acidic soils that formed in thick beds of eolian, fluvial, or marine sands on broad, nearly level to very steep uplands in the Lower Coastal Plain. Depth to seasonal water table is more than 80 inches. All horizons are sand or fine sand with 5 to 10 percent silt plus clay in the 10- to 40-inch control section. Slopes are dominantly 0 to 12 percent but range to 85 percent in dissected areas (U.S. Agriculture, 1995).

The key chemical and physical properties of the Lakeland soils generally include:

- ≥ 90 percent quartz sand.
- < 1 percent organic matter.
- Acidic pH (4.5 to 6.0).
- Extremely low Cation Exchange Capacity (CEC) values (< 4 meq/100g).
- Rapid infiltration rate.
- Very high hydraulic conductivity of 20 to 28 inches per hour.

The resulting condition of a typical Lakeland soil is generally characterized as:

- Excessively drained.
- Poor soil structure (low cohesion, adhesion, and aggregate stability).

- Low fertility.
- Relatively low diversity, activity, and populations soil organisms (bacteria, actinomycetes, fungi, algae, protozoa, arthropods, and earthworms).
- Absence of active soil-forming processes.

The unique combination of almost pure sand texture, very high soil infiltration and hydrologic conductivity, and high rainfall (approximately 62 inches per year) has created a distinctive landscape of potentially high soil constituent leachability and low biodegradation potential (U.S. Agriculture, 1995).

Dorovan Series

The Dorovan series consists of very poorly drained, moderately permeable soils on densely forested flood plains, hardwood swamps, and depressions of the Coastal Plains. They formed in highly decomposed acid-organic materials. Slopes range from 0 to 2 percent but are normally less than 1 percent. The organic material ranges from 51 to more than 80 inches thick. It is extremely acid or very strongly acid in the organic layers. It is strongly acid or very strongly acid in the 2C horizon. The soil is saturated to the surface most of the time. Runoff is very slow and water is ponded on the surface in depressions. The underlying mineral sediments commonly are loamy or sandy and are very strongly acid or strongly acid (U.S. Agriculture, 1995).

Chipley Series

The Chipley series consists of very deep, moderately well drained or somewhat poorly drained, rapidly permeable soils that formed in thick deposits of sandy marine sediments on uplands in the lower Coastal Plain. The soil frequently occurs in association with the Hurricane soil series. Slopes range from 0 to 8 percent. Texture is sand or fine sand to depths of 80 inches or more. Silt plus clay content between depths of 10 and 40 inches is 5 to 10 percent. Reaction ranges from extremely acid to moderately acid in the A horizon except where limed and from very strongly acid to slightly acid in the C horizon (U.S. Agriculture, 1995).

Foxworth Series

The Foxworth series consists of very deep soils that formed in sandy marine or eolian sediments. These soils are on broad, nearly level, and gently sloping uplands and sloping to steep side slopes leading to drainageways. Slopes range from 0 to 8 percent but most commonly are 0 to 5 percent. Runoff is very slow and permeability is rapid or very rapid. A water table fluctuates between depths of 48 to 72 inches below the soil surface for 1 to 3 months during most years and 30 to 48 inches for less than 30 cumulative days in some years. Thickness of sand exceeds 80 inches. Reaction ranges from very strongly acid to slightly acid throughout. Texture is sand or fine sand throughout and silt plus clay content in the control section is 5 to 10 percent (U.S. Agriculture, 1995).

Hurricane Series

The Hurricane series consists of very deep soils that formed in sandy marine sediments. These soils are on nearly level to gently sloping, low, broad landscapes that are slightly higher than the adjacent flatwoods of the Lower Coastal Plain. Slopes range from 0 to 5 percent. Hurricane soils are somewhat poorly drained. Runoff is slow and permeability is very rapid or rapid in the A and E horizons and moderately rapid in the Bh horizon. A water table is at depths of 2 to 3.5 feet for 3 to 6 months during most years and at depths greater than 3.5 feet the remainder of the time. Some areas are subject to flooding for brief periods. The solum is 60 inches or more thick. Depth to the spodic horizon is 51 to 79 inches. Reaction ranges from moderately acid to extremely acid throughout (U.S. Agriculture, 1995).

Rutledge Series

The Rutledge series consists of very deep, very poorly drained soils with rapid permeability formed in sandy unconsolidated Coastal Plain sediments of marine origin. The Rutledge soils are on upland flats, flood plains, or depressions with planar or convex surfaces. They are also in depressions such as bays, basins, or sinks. The water table is near the surface for long periods of the year and ponding is common in depressional areas. Runoff is ponded or very slow and permeability is rapid throughout. Silt plus clay in the 10 to 40 inch control section averages 5 to 15 percent. The soil is extremely acid to strongly acid throughout, unless it has been limed. Slopes range from 0 to 2 percent (U.S. Agriculture, 1995).

Udorthents

Udorthents are materials in areas from which sand and loamy materials have been removed (e.g. through borrow pit excavation). The typical depth of excavations in Okaloosa County ranges from 2 to 12 feet. The removed soil material was likely used in construction and road repair. Due to extensive mixing, identification of component soils is not possible. Udorthent soils are often barren and are not suitable for cultivation (U.S. Agriculture, 1995).

Best Management Practices for Preventing and Controlling Erosion

Soil Erosion Control

Soil erosion control is the prevention of soil particle displacement (erosion control); detention and/or diffusion of concentrated, uncontrolled water flow (runoff control); and control of the movement and deposition of displaced soil particles (sediment control). These soil erosion control concepts are discussed in the following sections.

Erosion Control

Erosion control is based on the application of relatively simple yet effective measures that prevent the displacement of soil particles by rainfall impact, water flow, or wind by increasing the resistance to detachment and/or reducing the transport capacity of storm water runoff (Fifield, 1994; Grace et al., 1998). The principal means of achieving this objective is to create an environment that promotes the establishment of long-term, self-sustaining vegetative

communities that are naturally engineered to anchor soil and diminish the erosive energy of flowing water.

The significance of accelerated erosion and sedimentation increases exponentially with increasing land pressure. As more land is exposed to erosion, the uncleared lands, which act as sediment traps between the eroding site and the streams, becomes less significant and a greater proportion of the eroded material enters the streams. Based on an extensive historical study of man-induced erosion on the Southern Piedmont, Trimble (1974) concluded that a given amount of soil loss occurring in a relatively short time is far more significant to stream sedimentation than the same loss extended over two centuries at lesser land pressures. Within this context, the design and implementation of erosion control measures on disturbed sites become critical to reducing cumulative impacts to aquatic ecosystems.

Although erosion and sediment control are often used in the same context, the approach exercised by these methods is quite different. The primary difference is that erosion control practices offer an offensive strategy of attacking the sources of sediment, while sediment control is a stopgap defensive strategy of treating symptoms after the damage is done (Theisen and Agnew, 1993). It is important to employ erosion and sediment control practices jointly and not to rely on one method to the exclusion of the other.

The four principles of erosion control presented in the general order of design and implementation are as follows:

1. Manufacture Stable Slope Grades

Soil erosion damage to slopes often creates an irregular, unstable profile that further accelerates water flows and inhibits vegetation occupancy. A slope, which is inherently unstable, will not support satisfactory vegetative cover until it has created a stable angle of repose whether by the process of erosion or mechanical reconstruction. A stable slope angle of repose minimizes erosion potentials and encourages the establishment of vegetation.

2. Recondition Damaged Soils

Soil is a living media that is host to a diversity of structural, chemical, and biological (soil flora and fauna) interdependent constituents. Changes in the structure, chemical composition, or populations of microbial life will diminish the capacity of soil to support vegetation. In a damaged, dysfunctional state, soils are easily eroded, overall ecosystem functions are adversely impacted, and water quality decreases. Reestablishing vegetation is dependent on restoring the health and functions of soil environments.

Many EMR soils are structurally damaged or are depleted of vital soil components necessary for supporting vegetative growth. Soil reconditioning promotes soil structural stability; stimulates increases in the diversity, populations, and activity of soil organisms; restores soil humus components; and promotes nutrient recycling and soil water retention.

3. Establish Permanent Vegetative Cover

Vegetative covers provide the best-known soil protection. Stable vegetative cover minimizes the effects of raindrop impacts, reduces the velocity of runoff, hold soils in place, tends to be self-healing, is generally less expensive compared to structural features, and is often the only practical long-term solution for stabilization and erosion control on most disturbed sites. Revegetation does require thorough planning and maintenance. Site investigations and planning for vegetation stabilization reduces its cost, minimizes maintenance and repair, and makes other erosion and sediment control measures more effective and less costly to maintain.

Grasses are particularly well adapted to erosion control. A 10,000 square foot patch of dense sod can contain up to 8 million individual grass plants with an estimated 3 billion miles of root system (Yost, 1996). The shielding effect of the plant canopy and leaves is augmented by roots and rhizomes that hold the soil in place, improve the soil's physical condition, and increase the rate of infiltration, further decreasing runoff. Plants also remove water from the soil through transpiration, thus increasing its water absorbing capacity.

4. Stabilize Slope Soils

Even under stable grades, bare soil is still susceptible to erosion. In lieu of vegetative cover establishment or in combination with planting, measures are taken to minimize the detachment and transport of soil particles resulting from raindrop impact and surface flows. Mulching practices are employed to provide a protective cover that complements soil stability, soil quality improvement, and the establishment of vegetation.

Runoff Control

The natural tendency of water is to channelize, suspend soil particles and other materials to the degree possible, and race downhill towards stream outlets. As water gains speed, the suspended soil materials act as sandpaper grinding away at the channel bottom and banks. Offered the opportunity to continue to concentrate, flowing water columns follow the line of least resistance, producing incisions in the landscape known as rills and gullies.

The success of most erosion control practices is dependent on the installation of runoff control practices that apply theoretical brakes to concentrated, uncontrolled water flow. The results of reductions in the velocity of water flow can be quite dramatic. If downhill water flow is reduced by half, the erosion-causing capacity is reduced by a factor of 4, the amount of sediment carried downhill is reduced approximately 34 times, and the size of particles than can be pushed or rolled is reduced 64 times (Roley, 1994). It becomes quite evident that slowing down the flow of water effectively reduces its erosive potential. The three principles of runoff control are as follows:

1. Transport Runoff Within Non-Erosive Water Conveyance Systems

Drains frequently transport water at volumes and velocities beyond what would be encountered for that site under natural undisturbed conditions. It is therefore critical that the channels are designed and constructed to manage water flows in a manner that does not cause the deterioration and erosion of the channel and that vegetative and structural measures be installed to control erosive channel flows.

2. Intercept and Diffuse the Erosive Energy of Runoff at Predetermined Intervals

Vegetative and structural measures are installed at design intervals along water flow paths to intercept and disrupt flow without recreating a concentrated water flow problem in another location. A chronic problem experienced by some engineered structures, such as in-channel check dams, is the interception and reconcentration of water flow energy in areas sensitive to erosion. Vegetative and/or engineered structural measures are used to intercept and diffuse the erosive energy of moving water. An underlying principal is that smaller water volumes are easier to control and have a lower sediment transport capability compared to larger water volumes.

3. Transition Water Flows to Non-Erosive Discharge Points

The interception of water creates a discharge behavior that may be as erosive as the initial energy intercepted. Structural measures are used at outlet points to release water under non-erosive conditions.

Sediment Control

Sediment control must be implemented at the proper time and location in order to be effective. For example, collecting lost soil resources with hay bales or sediment traps at the stream discharge point provides no long-term benefit to reducing the damage and loss of soil resources at the uphill points of origin. Although providing water quality protection, these types of sediment controls are quickly overwhelmed by sediment loading if erosion and runoff control practices are not jointly installed.

References:

- Fifield, J. S., 1994. What is required for effective sediment control? *Land and Water*, 38:39-40.
- Grace, J. I. M., B. Rummer, B. J. Stokes, and J. Wilhoit, 1998. Evaluation of erosion control techniques on forest roads. *Transactions of the ASAE*, pp. 383-391.
- Roley, W., 1994. Watershed Management and Sediment Control for Ecological Restoration. *Land and Water*, 38:16-17.
- Theisen, M. S. and W. Agnew, 1993. The Expanding Role of Geosynthetics in Erosion and Sediment Control. *Land and Water*. January/February 1993.
- Trimble, S. W., 1974. Man-Induced Soil Erosion on the Southern Piedmont 1700-1970. *Soil Science Society of America*.
- U.S. Department of Agriculture, 1995. Soil Survey of Okaloosa County, Florida. Soil Conservation Service.
- Yost, D. G., 1996. Vegetative Cover for Erosion Control. *Land and Water*. pp. 24-25.

(This page is intentionally blank.)